NASA Facts

National Aeronautics and
Space Administration
Lewis Research Center
Cleveland, Ohio 44135–3191

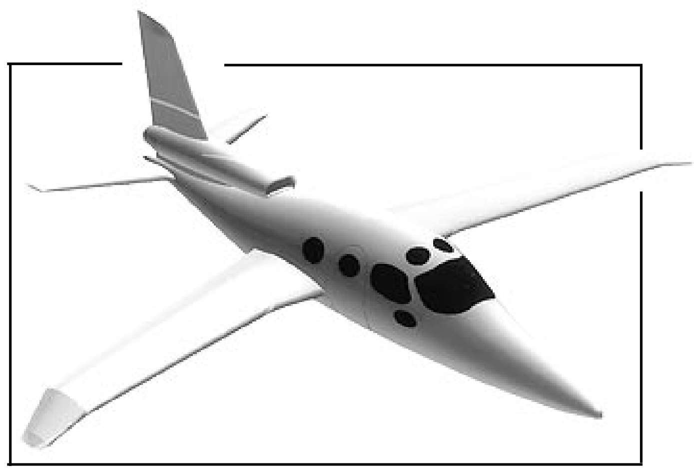
FS–1997–07–001–LeRC

Making Future Light Aircraft Safer, Smoother, Quieter, and More Affordable

Lewis Propulsion Program Will Help Revitalize U.S. General Aviation

Since the early 1980's, the production of general aviation light aircraft (such as those used by private pilots) has been in a severe downturn. Pilots blame the high cost of flying and the extensive time required to learn how to fly, and aircraft manufacturers cite huge increases in industry liability costs, changes in the tax code, increasing complexity of the national airspace system, and the oil crisis of the early 1980's as additional factors. The industry has estimated that over the last 15 years U.S. light aircraft manufacturers spent over $3 billion on product liability expenses alone, robbing resources that could have been invested in research and technology development.

The General Aviation Revitalization Act of 1994 redressed the liability issue, and fuel availability and cost have stabilized. Economic conditions coupled with an average age of almost 30 years for the existing fleet of general aviation light aircraft, indicate the potential for a worldwide rebound in this market. Unfortunately, economic problems experienced by the industry over the last 20 years have prevented much investment in product improvement and research and development. This is especially true of propulsion systems. Although current general aviation engines are good and have served their purpose well, they require a considerable amount of pilot attention, intrude on passenger comfort with noise and vibration, and are costly to buy, operate, and maintain.



V–JET I general aviation concept aircraft powered by revolutionary new turbine engine.

For the United States to maintain leadership in this market and attract new customers, aviation products must be modernized with a focus on safety, low cost, ease of use, and comfort. The challenge of foreign competition has made such an effort imperative.

Replacing today's outdated light aircraft propulsion systems is perhaps the most important factor in revitalizing the light aircraft market.[1] New engines are crucial to truly new airplane designs.

NASA has joined with industry in the General Aviation Propulsion (GAP) program to develop two new engines that will be the forerunners of the next generation of general aviation light aircraft engines.

[1] NASA Aeronautics Advisory Committee's General Aviation Task Force Report, September 1993.

These engines will change our concept of general aviation propulsion systems. They will bring about a revolution in affordability, ease of use, and performance. With their smooth, quiet operation, they will provide a level of comfort never before enjoyed in general aviation light aircraft. These new engines promise to be the key to creating new demand for aircraft and to revitalizing the U.S. general aviation industry. The potential is especially strong when the benefits of the new propulsion systems are coupled with those of cockpit and airframe technologies being developed by the NASA–FAA–industry Advanced General Aviation Transport Experiment (AGATE) consortium.

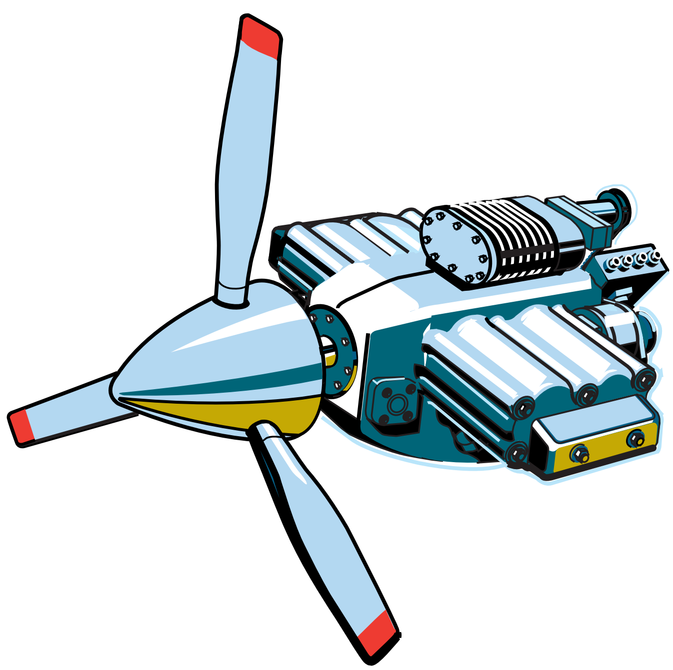
NASA's GAP program consists of two elements: the Intermittent Combustion (IC) Engine Element and the Turbine Engine Element. By the year 2000, NASA and its industry partners will develop a revolutionary new piston engine in the IC Engine Element and a revolutionary new turbofan engine in the Turbine Engine Element. That year, both of these engines will be flight demonstrated to the public at the Experimental Aircraft Association's Oshkosh Fly-In. Commercially produced engines based on these demonstrator engines and their manufacturing technologies will soon follow.

Intermittent Combustion Engines—The CSD 283 Piston Engine

GAP's IC Engine Element addresses the type of engines used today in light aircraft and automobiles. This Element will demonstrate a new propulsion system for entry-level aircraft. Such aircraft are usually characterized by a single engine, no more than four seats, cruising at less than 200 knots, and easy, well-mannered handling characteristics. The goal of the IC Engine Element is to reduce engine prices by one half while substantially improving reliability, maintainability, ease of use, and passenger comfort.

To achieve this goal, Teledyne Continental Motors, its partners (Aerotronics, Cirrus Design, G.S. Engineering, Hartzell Propeller, Lancair International, and New Piper Aircraft), and its subcontractor (Perkins Technology) have teamed with NASA to develop a highly advanced piston engine. To be known as the CSD 283, this 200-hp engine will incorporate many innovations. It will be a horizontally opposed, four-cylinder, liquid-cooled, two-stroke diesel engine. Diesel engines are well known as very reliable but heavy. However, combining the two-stroke operating cycle with innovative, lightweight construction will make the CSD 283 lighter than today's aircraft engines.

The CSD 283 will be combined with advanced design, low-speed propellers (from related



Four-cylinder diesel engine.

NASA-industry research) to offer very quiet operation for both airport neighbors and aircraft passengers. Leaded gasoline will be a thing of the past. Instead, the CSD 283 will burn jet fuel at a low fuel consumption rate of 0.36 pounds per horsepower-hour, significantly better than the 0.41 to 0.49 values for today's engines.

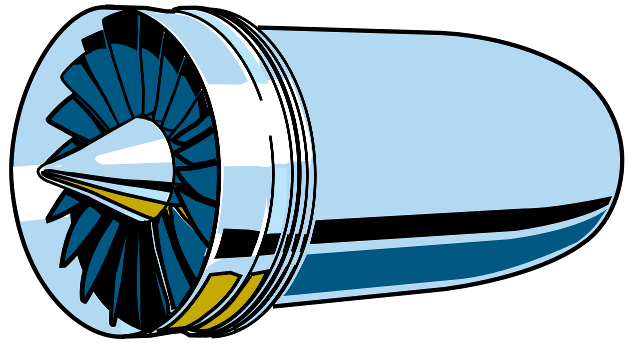
This engine will provide the same kind of quiet, easy-to-use power that has become the standard in the automotive world. There will be no fuel-air mixture or propeller pitch control to contend with; a single power lever will control the engine and propeller. Special care will be taken in the design of the engine to ensure smooth, vibration-free operation. Along with these vast improvements in engine operation and performance, the CSD 283's unique design features and the development of low-cost manufacturing methods will reduce engine costs, the goal being 50 percent over current engines.

Turbine Engines—
The FJX–2 Turbofan Engine

GAP's Turbine Engine Element addresses the type of engines currently used in commercial passenger aircraft. It will demonstrate a new propulsion system concept for higher performance light aircraft, which usually have four to six seats and cruise at 200 knots or better.

Modern turbine engines are highly desirable for light aircraft because they are user friendly and environmentally compliant. Their characteristics include very high reliability, smooth operation, use of readily available jet fuel, and low noise and emissions. Their reliability and smoothness contribute greatly to aircraft safety. Although turbine engines would seem to be ideal propulsion systems, their high acquisition cost has impeded significant applications in the light aircraft market.

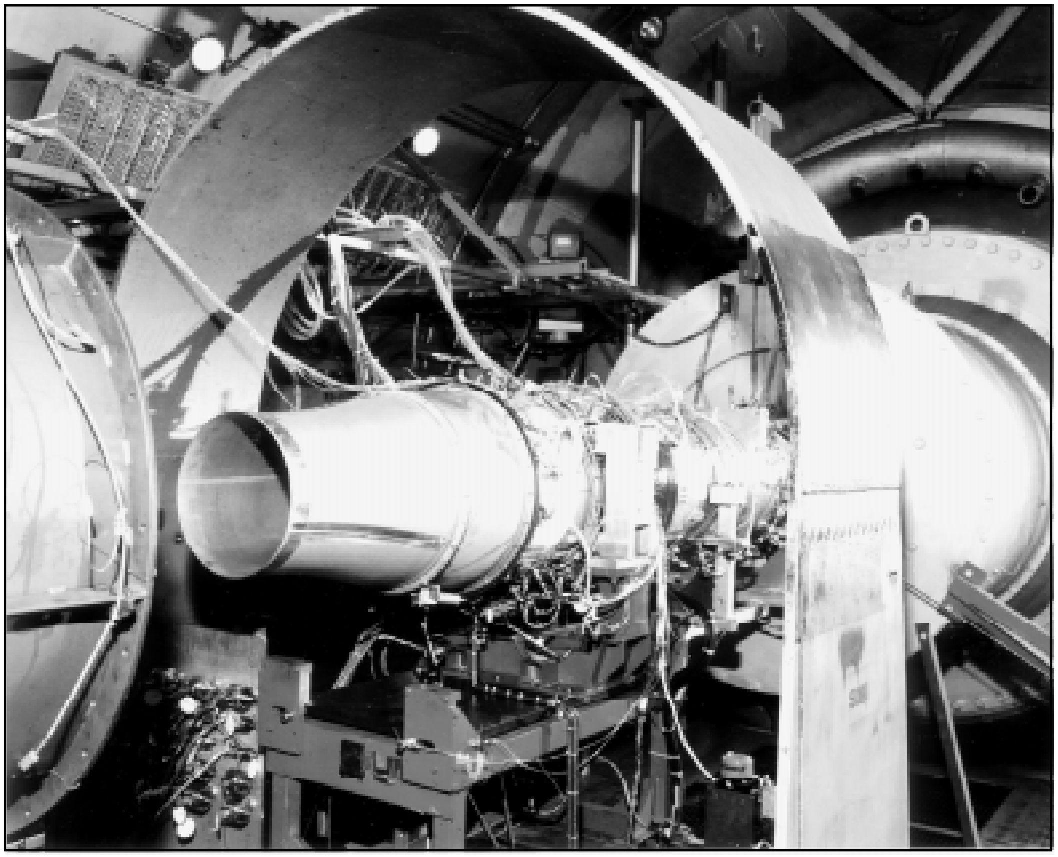
Reducing the price of small turbine engines by a factor of 10 (from hundreds of thousands to tens



High-bypass turbofan engine.

of thousands of dollars) is the primary goal of the Turbine Engine Element.

Williams International, its partners (California Drop Forge, Cessna Aircraft, Chichester-Miles Consultants, Cirrus Design, Forged Metals, New Piper Aircraft, and VisionAire), its subcontractors (Producto Machine, Scaled Composites, and Unison Industries), and its consultant (Raytheon Aircraft) have teamed with NASA to develop a truly revolutionary turbine engine that will set a new standard for general aviation engines. The FJX–2 high-bypass-ratio turbofan engine will produce 700 pounds of thrust yet weigh less than 100 pounds, about one-third of current piston propulsion systems with similar capabilities. To keep costs low, the FJX–2 team will apply many lessons learned from the research and development of automotive gas turbine engines. Emphasis will be placed on simplifying and reducing the number of parts. The goal is that such low-cost design techniques, combined with the development of advanced automated manufacturing methods, will lead to the first turbine engine that is cost competitive with piston engines. Aircraft powered by commercial derivatives of this engine will have the performance to avoid inclement weather and to minimize travel time. They will do this with a takeoff-to-landing fuel burn equivalent to or less than that for today's comparable piston-powered aircraft.



NASA resources once reserved for large commercial transport engine programs are now being made available to the general aviation industry. For example, Lewis' Propulsion Systems Lab, which was designed for testing much larger engines, is used here for the Williams FJ44–2 Turbofan engine.

The Next Generation

With these new engines, general aviation will take an exciting leap forward. Commercial derivatives of these engines will provide a previously unheard of level of comfort and convenience, and the performance-to-price ratio will soar. Flying will not only be fun, but comfortable and affordable!

For more information contact

Information and Publications Office
MS 8–1
NASA Lewis Research Center
Cleveland, OH 44135–3191
(216) 433–5573

AUG 97
B-0820A